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- (54) **Method and apparatus for processing potentially explosive and sensitive materials for forming longitudinally perforated extrudate strands.**

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## Description

The invention relates to a multiple pin die component for receiving extrudate from a mixer or other source of flow under pressure and discharging the material in a cylindrical configuration having a plurality of axially extending perforations, comprising:

- a) a shell having an entrance channel and a discharge channel,
- b) and a plurality of elongate pins axially extending into said discharge channel to form said perforations as said material exits.

The invention further relates to a die assembly comprising a plurality of multiple pin die components of the above defined structure.

Multiple pin dies of this kind mainly are used for the extrusion of materials which are sensitive to dehomogenization and degradation, and more specifically explosive materials that are extruded in the form of longitudinally perforated strands which are cut into pellet-size lengths. Typical materials encountered in the art with which this invention is concerned comprise highly viscous substances with entrained particulate solids. The material is discharged from either a continuous or batch mixer as a highly viscous fluid with entrained particulate solids of explosive materials, such as nitramines, encased in a synthetic plastic binder. A typical binding plastic is cellulose acetate butyrate with a solvent, which solidifies with solvent vaporization on being extruded from the multiple pin dies which are employed.

Continuous mixer-extruders of the type disclosed in US-A-4,744,669, can be utilized to mix and extrude such energetic material. The machine disclosed in that prior publication is a twin screw, co-rotating, self-wiping, fully intermeshing, continuous mixer with in-line extrusion capability. Typical energetic materials may be identified as single-base propellants (nitro-cellulose), double-base propellants (nitro-cellulose plus nitroglycerin or other liquid explosive), and triple-base propellants (nitro-cellulose plus nitro-glycerin plus nitro-guanidine). An alternate method of producing gun propellants is the batch processing system wherein the product of sigma blade mixing is fed to a ram extruder which supplies the mixed material directly to the dies. Prior art extruding systems have not provided the homogeneity desired and have been characterized by a considerable pressure drop in the dies which facilitated the formation of secondary flow currents and dead spots.

A multiple pin die component of the above defined kind (according to the preamble of claim 1) is known from US-A-3,447,203. It comprises a convergent die bush, having a pin carrier positioned at the entry end of the die, and on which is mounted

an array of long flexible pins each anchored in the pin carrier and able, during an extrusion, to follow the plastic flow pattern in the extrusion.

It is the object of the invention to provide a multiple pin die component and a die assembly comprising a plurality of such die components which are designed to promote flow of the material through the dies at a more uniform shear rate with reduced pressure drop, eliminating dead spots, countercurrent flows, disruptions of the flow and abrupt changes in flow direction.

This object is solved according to the invention by the following characterising features:

c) said shell includes an axial core connected to the shell by radially directed ribs having upstream convergent surfaces, the ribs defining a plurality of axially extending passages circumferentially between the ribs through which flows of material proceed from the entrance channel to the discharge channel; and

d) said core comprises a conically projecting member at its axially upstream end penetrating the flow stream and distributing the flow uniformly to said passages.

The invention, therefore, provides a system which more safely processes the material and reduces the pressure drops through the dies by as much as 50%, while producing an improved quality extrudate.

Furthermore, the invention provides a system which can be more readily manufactured and temperature controlled and which facilitates interchanging of the die parts without the necessity of replacing the entire die. The perforation pin geometry of the dies can be varied without interchanging the entire dies.

Other objects and advantages of the invention will be pointed out specifically, or will become apparent from the following description.

Figure 1 is a sectional, elevational view illustrating a prior art die;

Figure 2 is a top plan view thereof, taken on the line 2-2 of Figure 1;

Figure 3 is a schematic, sectional, elevational view illustrating a prior art ram extruder of the type used in a batch process for extruding energetic material through dies of the structure disclosed in Figures 1 and 2;

Figure 4 is a schematic diagram illustrating the parabolic velocity distribution incident to laminar flow of a viscous fluid through a passage;

Figure 4A is a view illustrating the secondary flows which are created when an abrupt change of direction occurs in a flow passage;

Figure 5 is an end elevational view illustrating a die assembly with incorporated multi-pin die components;

Figure 6 is an elevational view taken on the line 6-6 of Figure 5 to illustrate the interior face of one of the manifold halves;

Figure 7 is a top plan view taken on the line 7-7 of Figure 6;

Figure 8 is a top plan view of one of the multiple-pin die components;

Figure 8A is an inverse sectional plan view taken on the line 8A-8A of Figure 9;

Figure 9 is a sectional, elevational view taken on the line 9-9 of Figure 8;

Figure 10 is a fragmentary, sectional, elevational view taken on the line 10-10 of Figure 8;

Figure 11 is a schematic, top plan diagram illustrating the progressive configuration of the passages in the manifold at a location where the flow of material is branched;

Figure 12 is a fragmentary, sectional, plan view taken on the line 12-12 of Figure 6;

Figure 13 is a similar view taken on the line 13-13 of Figure 6;

Figure 14 is a similar view taken on the line 14-14 of Figure 6;

Figure 15 is a similar view taken on the line 15-15 of Figure 6;

Figure 16 is a similar view taken on the line 16-16 of Figure 6;

Figure 17 is a similar view taken on the line 17-17 of Figure 6; and

Figure 18 is a similar view taken on the line 18-18 of Figure 6.

A typical prior art die structure is disclosed in Figures 1 and 2. Figure 3 is a schematic view of a typical ram extruder which is employed to receive mixed material from a conventional sigma mixer and supply it to several such dies. It incorporates a cylinder 10, fixedly supported by a frame, generally designated 11, which also fixedly mounts a hydraulic cylinder 12 directly above, and in axial alignment with, the cylinder 10. Oil inlet and outlet openings 13 and 14 are provided in the cylinder 12 which mounts the usual displaceable ram piston 15, piston 15 extending through a sealed opening 16 in the lower end of closed cylinder 12 down into the open sealed upper end of cylinder 10. Provided in the lower wall of cylinder 10 are counterbored openings 17 which receive the dies, generally designated D, which are disclosed more particularly in Figures 1 and 2.

The prior art dies units are shown as each made up of an upper, mass-receiving spider ring, generally designated 18, and a lower discharge member 19. Ring 18 includes an outer wall 18a connected to an inner cylindrical core 18b by integral ribs 18c which are circumferentially spaced apart to define inlet openings generally designated 20 between them. Discharge member 19 is shouldered as at 19a to fit one of the counterbored

openings 17, and has a shallowly convergent, frusto-conical transition inlet 21 leading to a cylindrical discharge passage 22. Provided within the core 18b are a series of openings 23 within which elongate pins 24 are fixed, the pins 24 extending downwardly toward the exit orifice 25 in discharge member 19.

When the ram piston 15 is raised up out of cylinder 10, a supply of mixed material can be dropped into the cylinder 10. Lowering of the ram 15, under the hydraulic pressure exerted by supplying hydraulic fluid through opening 13, while egressing it through opening 14, causes the product to be extruded through each die D in the form of a cylinder which has longitudinal perforations created by the axially parallel pins 24.

At least two principal disadvantages of a serious nature are experienced with the structure described. The first of these is a considerable dehomogenization, or unmixing, of the product in cylinder 10 and the dies D, and the second is the excessive pressure drop which occurs, particularly when the material passes through the dies D. As Figure 4 illustrates, a viscous newtonian fluid flowing between parallel surfaces has a parabolic fluid velocity distribution, because the fluid tends to adhere to the walls of the passage. The velocity of flow at the walls is zero and reaches a maximum at the center or axis of the passage, as indicated. The rate of change of the velocity in the y direction is defined as the shear rate, which varies between a maximum at the passage wall to zero at the center of flow, and an excessive shear rate for the viscosity involved creates undue shear stresses. It has been noted that solid explosive particles mixed with a viscous binder fluid tend to migrate toward the lower shear stress zones, if certain shear differentials are exceeded. This phenomenon is also affected by the temperature of the fluid, which affects viscosity as well as the shear rate.

Figure 3 indicates what happens when abrupt changes are made in the cross-section of a flow channel. Here the continuity of flow in the direction a is disrupted by recirculating secondary flows b. Sharp discontinuities in shear rate take place and the probability of dehomogenization is very high. A similar condition occurs when there is an abrupt change in the direction of flow as indicated in Figure 4A where, again, the direction of flow is indicated at a and the secondary flows are indicated at b. This is what occurs when the mass is forced against the upper surfaces of the ring 18 in Figure 1 and is forced to turn 90°. In the secondary flow zones the product, slowly recirculating under pressure, becomes unmixed in the sense that fluid is gradually expelled from the mass, which turns into a semi-solid and stagnates. In explosives production, serious hazards are created

by the degradation which can occur in such a stagnated pocket. It is noted that the inlet 21 in Figure 1 also creates an abrupt flow direction change which creates a greater shear stress at this location as well as contributing significantly to pressure drop in the material proceeding through the die.

In Figures 5-8 a die assembly is disclosed which may be used with a continuous extrusion system of the type shown in US-A-4 744 669. As will be seen, the change in direction in flow is maintained at a value of substantially  $15^\circ$  or less off the axis of flow leading to it throughout the system.

The die assembly, identified generally at M, includes identical mating halves 26, each of which is provided with an entrance channel 27 of semi-circular cross-section which gradually merges into, a semi-figure eight shaped in cross-section passage 28. The inlet opening 70 formed by mating channels 27 in the halves 26 and the merging passage, which tapers when viewed endwisely (Figure 5) at an angle  $\underline{x}$  of fifteen degrees or less, receives the material from the exit orifice of the continuous mixer disclosed in the aforementioned US-A-4,744,669. From the circular entrance formed by channels 27, the composite inlet opening 70 is of generally figure-eight section to the level 29 where it is of the constant configuration disclosed in Figure 12 until the passage begins to diverge. The two overlapped, semi-circular openings 28a and 28b provided in each manifold half 26 define a passage of figure eight configuration with saddles 28c which, from about the Figure 12 level, gradually neck into extinction at the location 29a (Figure 13) where a pair of passages 30 of elliptical cross-section (see Figure 13) formed as adjacent bores of semi-elliptical section in each half 26, curve away at an angle  $\underline{c}$  approximating  $15^\circ$  (see Figure 6). From the Figure 12 level to the Figure 13 level the passage 28 gradually changes or merges to the Figure 13 configuration as demonstrated in Figure 11.

At 30a, each passage 30, which, as Figure 14 indicates, is circular in section at right angles to its axis, recurves at substantially the same angle  $\underline{c}$  about a radius  $\underline{r}$  taken from a point 31 on a diametral line 32 at a location where the circular passages 30 are vertical again and begin to merge to passages 30b of diverging figure-eight cross-section (Figure 16) to provide a diverging transition to further branching. Radius  $\underline{r}$  is maintained at a value greater than 8 times the radius  $\underline{r'}$  of annular passages 30 (Figure 15). At level of line 32, each passage 30 begins to diverge and gradually change its configuration to the figure-eight cross-section disclosed in Figure 16. This cross-sectional area is at a maximum immediately upstream of the

line 34 where the cross-sectional configuration is as demonstrated in Figure 17 and the material flow diverges to passages 35 of circular cross-section at right angles to their axes of extent. Each passage 35 is comprised of semi-circular recesses in the halves 26 of the same size as the recesses forming passages 30. The transition from each annular passage 30 to the pairs of passages 35 is accomplished in the same manner as the initial transition to passages 30, via mergent surfaces 30c leading to saddles 35c at the same angle  $\underline{x}$ . The saddles 35c gradually neck in, as previously, as the passage of figure-eight section grows in width in Figure 6, while remaining unchanged in depth (Figure 5), and then merges to passages 35 in the same manner. At the level of line 34, passages 30b branch at the same angle  $\underline{c}$  of approximately  $15^\circ$  to form the passages 35 which then recurve at their lower ends as at 35d to join to diverging die entrance channels 36 of gradually increasing circular cross-section. The channels 36 communicate with the die accommodating bores 37 of circular cross-section provided in the lower end of the manifold formed by manifold halves 26. The passages 35 and the channels 36 are similarly formed by semi-circular section recesses 35a and 36a provided in each manifold half 26 and the bores 37 are formed by semi-circular section recesses 37a provided in each mating manifold half 26. No change of direction greater than  $15^\circ$  occurs in the flow passages provided by the mating halves 26. The manifold halves 26 are provided with mating heat transfer passages 26a which provide a network of distributed channels for a recirculating heat transfer fluid. Plugs 26b may be appropriately provided in various locations.

At the lower end of each die assembly M in Figures 5 and 6, is a die mounting plate 38 which receives the die components generally designated C which comprise an integral part of the present invention. While the system described accommodates four sets of such die components C, which are more particularly illustrated in Figures 8-10, a fewer or greater number of die components C may be involved. Figures 8-10 particularly illustrate how each of the die components C is fabricated in a manner to facilitate its ready disassembly. Thus, each die component C includes an upper receiving member, generally designated 39, having a lower flange 40 (Figure 9) received in a recessed opening 41 provided in a lower discharge member, generally designated 42, having a shouldered flange 43. The counterbores 44 (Figure 6), provided in plate 38 receive the members 42 in the manner indicated, with each member 39 received in the bore 37 provided for it, as illustrated.

Each of the members 39 comprises an outer ring, generally designated 39a, separated from a

core, generally designated 39b, by radial ribs, generally designated 39c, which define a plurality of spaced apart elongate, segmental passages 45 surrounding core 39b. The configuration of passages 45, through which the mass is passed to a divergent frusto-conical passage 42a in the member 42, which communicates with the cylindrical discharge channel 42b in the lower end of member 42, will be presently described.

Each core 39b is centrally bored as at 46 to receive a pin 47, the reduced threaded upper end 47a of which receives a flow dividing member, generally designated 48, having a threaded bore 48b. Each member 48 is formed with a conical portion 48a extending up into the die entrance channel 36 and terminating in a cylindrical portion 48c. Tapered portion 48a extends at an angle  $\theta$  from the axis of core 39b and the direction of flow  $z$ . At its lower end, pin 47 is threaded as at 47b to receive an internally threaded sleeve member 49 which extends into the divergent passage 42a and includes a cylindrical portion 49a and a conical portion 49b. A series of bored openings 50 provided in the portion 49b fixedly mount the elongate pins P, which extend from the passage 42a to the exit end of the discharge channel 42b and form the longitudinal perforations in the product expressed as a cylinder from the discharge channel 42b.

It will be noted that the upper inner wall of the outer ring 39a of member 39 is inclined at an angle  $f$  to the direction of flow, as at 51, and that each of the marginal walls of passages 45 is made up of radial and circumferential, downwardly and inwardly sloped surfaces 45a and 45b respectively, sloping at the same angle in a downward direction. The adjacent radial surfaces 45a of each rib 39c slope from a radial ridge-line 45c to the ends of adjacent reduced metering necks 45d in the passages 45 intermediate the ends of flow passages 45. Convergent downwardly and inwardly sloped surfaces 45b slope to form the opposite sides of each neck 45d, which, in plan, is generally oblong in configuration. The lower portions of passages 45 are similarly configured in an axial direction, except vertically reversed. They are formed by diverging radial and circumferential walls 54 and 54a, respectively, and circumferentially inner and outer vertical walls 55. Passages 45 are thus generally hour-glass shaped in vertical cross-section as shown in Figure 9.

It is to be emphasized that each of the angles  $\theta$ ,  $f$ ,  $g$ ,  $h$ ,  $i$ ,  $j$ ,  $k$ , and  $l$ , are  $15^\circ$  or less so that no abrupt turns or corners are presented within which secondary flows can occur, and in which dead spots of material can accumulate. The passages 45 between ribs 39c are of the configuration disclosed and converge in this configuration down to each neck 45d. They then diverge outwardly in the same configuration to empty into convergent passage

42a. The ribs 39c are shown in cross-section in Figure 10 and, as shown have convergent upper, lower, and side surfaces. There is a pressure drop in the discharge channel 42b of each of the die components C which is far greater than the pressure drop anywhere else in the system. The pressure drop in discharge channel 42b is the only pressure drop which is significant in the present design wherein the pressure drop is less than in the prior art devices by about 50%.

Because the various delivery and distributing passages are provided in a pair of identical mating die halves 26, the manufacture of the manifold assembly M flow passages is greatly facilitated. The network of mating heat transfer passages can also readily be provided in the separate halves 26 to accommodate a recirculating heat transfer fluid which cools the unit and prevents heat buildup therein. The potentially explosive viscous mass which is continuously delivered to the inlet opening 70 feeds smoothly through the passages in the manifold without any abrupt changes in direction greater than  $15^\circ$ . Similarly, when the flow is divided in the passages 36 by the conically shaped portions 48a of the die components C, there is no substantial pressure drop as the material is guided by the inlet portions of passages 45 to the metering necks 45d and then further is guided to the frusto-conical passage 42a by the discharge portions of the hour-glass-shaped passages 45. Pins P, which are secured at their inner ends by soldering, or otherwise, can be readily interchanged to provide the desired number of longitudinal passages of the desired configuration in the product extruded from the discharge channel 42b by substituting various sleeve members 49. As the solidifying product exits from discharge channels 42b, it is severed by a suitable cutter member into lengths comprising cylindrical pellets having axially parallel passages which are open at both ends.

## Claims

1. Multiple pin die component (C) for receiving extrudate from a mixer or other source of flow under pressure and discharging the material in a cylindrical configuration having a plurality of axially extending perforations, comprising:
  - a) a shell (members 39, 42) having an entrance channel (36) and a discharge channel (42b),
  - b) and a plurality of elongate pins (P) axially extending into said discharge channel (42b) to form said perforations as said material exits,
 characterized in that
  - c) said shell includes an axial core (39b) connected to the shell by radially directed

ribs (39c) having upstream convergent surfaces (45a), the ribs defining a plurality of axially extending passages (45) circumferentially between the ribs through which flows of material proceed from the entrance channel (36) to the discharge channel (42b); and

d) said core (39b) comprises a conically projecting member (48) at its axially upstream end penetrating the flow stream and distributing the flow uniformly to said passages (45).

2. Die component according claim 1 in which the entrance and discharge channels (36, 42b) and said axially extending passages (45) all extend at an angle in the neighborhood of about fifteen degrees or less off axis. 15
3. Die component according claim 1 in which said core (39b) has a generally conically projecting portion (49b) at its axially downstream end, and a plurality of axially extending elongate pins (P) extend from said downstream generally conical portion (49b) into said discharge channel (42b). 20
4. Die component according claim 1 wherein said passages (45) are of generally hour-glass configuration axially. 30
5. Die component according claim 1 in which said passages (45) have axially convergent inner and outer circumferential surfaces (45b) joined to axially converging inner and outer radial rib surfaces (45a) forming segment-shaped openings (necks 45d). 35
6. Die assembly (M) comprising a plurality of die components (C) according claim 1 and further comprising die channel block means (manifold halves 26) having an entrance channel (27) of circular cross-section merging to a passage (28) of figure-eight section (Fig.13) which diverges curvilinearly to a pair of separate branch passages (30) of circular cross-section (Fig.14) perpendicular to their axis of extent, said die components (C) being provided downstream of and communicating with said branch passages (30). 40
7. Die assembly according claim 6 wherein said core (39b) of each die component (C) has a conically projecting portion (48a) at its axially upstream end penetrating the flow stream and distributing the flow uniformly to said passages (45) while avoiding "dead spot" formation and dehomogenization, the said branch passages

(30), the conically projecting portion (48a), said entrance and discharge channel (36, 42b), and axially extending passages (45) all extending at an angle in the neighborhood of fifteen degrees or less off axis.

8. Die assembly according claim 6 wherein said figure eight-shaped passage (28) is formed by opposed saddles (28c) which gradually neck in to merge the figure eight passage (28) with the branch passages (30).
9. Die assembly according claim 6 wherein said branch passages (30) each curve radially as they diverge, and then recurve back on a radius (r) no less than eight times the radius (r') of the branch passages (30).
10. Die assembly according claim 9 wherein said recurved branch passages (30) of circular cross-section again merge to passages (30b) of figure-eight cross-section (Fig.16) which diverge to passages (35) of circular cross-section (Fig.18).
11. Die assembly according claim 8 wherein said die channel block means consists of two mating manifold halves (26) with the entrance channel (27), the passages (28) and the branch passages (30) half in each one, said saddles (28c) being in each of said halves.
12. Die assembly according claim 6 wherein said core (39b) has a conically projecting portion (49b) at its downstream end and said surrounding shell has a member (42) with a convergent passage (42a) of the same inclination as the conically projecting portion (49b), said portion (49b) projecting into said passage (42a), said pins (P) being mounted to project from said downstream conical portion (49b) in axial parallelism.

#### Patentansprüche

1. Ein mit einer Mehrzahl von Stiften versehenes Gesenkbauteil (C) zur Aufnahme unter Druck stehenden extrudierten Materials aus einem Mischer oder einer anderen Strömungsquelle und zur Abgabe des Materials in zylindrischer Gestalt mit einer Mehrzahl von sich in axialer Richtung erstreckenden Perforationen, enthaltend:
  - a) ein Gehäuse (Elemente 39, 42), mit einem Eingangskanal (36) und einem Ausgangskanal (42b),
  - b) und eine Mehrzahl von länglichen Stiften (P), die sich in axialer Richtung in den Aus-

- gangskanal (42b) erstrecken, um so bei der Abgabe des Materials die Perforationen auszubilden, dadurch gekennzeichnet, daß
- c) das Gehäuse einen Axialkern (39b) enthält, der mit dem Gehäuse über radial ausgerichtete Rippen (39c) verbunden ist, die strömungsobenseitig konvergierende Oberflächen (45a) aufweisen, wobei die Rippen eine Mehrzahl von sich in axialer Richtung erstreckenden, in Umfangsrichtung zwischen den Rippen angeordneten Durchgängen (45) bilden, durch die Werkstoffströme vom Eingangskanal (36) zum Ausgangskanal (42b) transportiert werden; und
- d) der Kern (39b) ein konisch vorstehendes Element (48) an seinem axial strömungsobenseitigen Ende aufweist, der in den fließenden Werkstoffstrom eindringt und diesen gleichmäßig auf die Durchgänge (45) verteilt.
2. Gesenkbauteil nach Anspruch 1, dessen Eingangs- und Ausgangskanäle (36, 42b) sowie die sich in axialer Richtung erstreckenden Durchgänge (45) in einem Winkel in der Größenordnung von maximal etwa  $15^\circ$  von der Achse abweichen.
  3. Gesenkbauteil nach Anspruch 1, in dem der Kern (39b) einen im wesentlichen konischen vorspringenden Bereich (49b) an seinem axial strömungsabseitigen Ende aufweist und in dem sich eine Mehrzahl von sich in axialer Richtung erstreckenden länglichen Stiften (P) vom strömungsabseitigen, im wesentlichen konischen Bereich (49b) in den Abgabekanal (42b) erstreckt.
  4. Gesenkbauteil nach Anspruch 1, wobei die Durchgänge (45) in axialer Richtung im wesentlichen stundenglasförmig ausgebildet sind.
  5. Gesenkbauteil nach Anspruch 1, in dem die Durchgänge (45) axial konvergierende innere und äußere Umfangsflächen (45b) aufweisen, die mit axial konvergierenden inneren und äußeren Radialrippenflächen (45a) zur Bildung von segmentförmigen Öffnungen (Rücken 45d) zusammengefügt sind.
  6. Gesenkvorrichtung (M) enthaltend eine Mehrzahl von Gesenkbauteilen (C) entsprechend Anspruch 1 und weiterhin enthaltend ein Gesenkkanalblockelement (Verteilerhälften 26) mit einem Eingangskanal (27) kreisförmigen Querschnitts, der in einen Durchgang (28) mündet, der im Querschnitt die Form der Ziffer 8 aufweist (Fig. 13) und sich in ein Paar von getrennten, sich voneinander weghiegender Zweigdurchgängen (30) aufteilt, die rechtwinklig zu ihrer Erstreckungsachse im Querschnitt kreisförmig sind (Fig. 14), wobei die Gesenkhauteile (C) strömungsabseitig gegenüber den Zweigdurchgängen (30) angeordnet sind und mit diesen in Verbindung stehen.
  7. Gesenkvorrichtung nach Anspruch 6, wobei der Kern (39b) eines jeden Gesenkbauteils (C) einen konisch vorspringenden Abschnitt (48a) an seinem axial strömungsobenseitigen Ende aufweist, der in den fließenden Werkstoffstrom eindringt und ihn gleichmäßig auf die Durchgänge 45 verteilt, während gleichzeitig die Bildung von sogenannten Totpunkten sowie die Entmischung vermieden werden, wobei die Zweigdurchgänge (30), der konisch vorspringende Abschnitt (48a), der Eingangs- und der Ausgangskanal (36, 42b) und axial sich erstreckende Durchgänge (45) in einem Winkel in der Größenordnung von höchstens etwa  $15^\circ$  von der Achse abweichen.
  8. Gesenkvorrichtung nach Anspruch 6, wobei der Durchgang (28), der in Form der Ziffer 8 gestaltet ist, durch einander gegenüberliegende Erhöhungen (28c) gebildet wird, die sich schrittweise einander annähern, um so den Durchgang (28), der in Form der Ziffer 8 gestaltet ist, in die Zweigdurchgänge (30) einmünden zu lassen.
  9. Gesenkvorrichtung nach Anspruch 6, wobei die Zweigdurchgänge (30) sich jeweils um einen bestimmten Radius biegen, während sie sich voneinander entfernen, um sich dann wieder zurückzubiegen, und zwar um den Radius (r), der mindestens das Achtfache des Radius' (r') der Zweigdurchgänge (30) beträgt.
  10. Gesenkvorrichtung nach Anspruch 9, wobei die Zweigdurchgänge (30) nach dem Zurückbiegen in Durchgänge (30b) einmünden, die wiederum im Querschnitt entsprechend der Ziffer 8 gestaltet sind (Fig. 16), und die sich in Durchgänge kreisförmigen Querschnitts (Fig. 18) aufteilen.
  11. Gesenkvorrichtung nach Anspruch 8, wobei das Gesenkkanalblockelement aus zwei sich ergänzenden Verteilerhälften (26) besteht, wobei der Eingangskanal (27), die Durchgänge (28) und die Zweigdurchgänge (30) jeweils zur Hälfte in jeder dieser Hälften ausgebildet sind, und wobei die Rücken in jeder dieser Hälften angeordnet sind.

12. Gesenkvorrichtung nach Anspruch 6, wobei der Kern (39b) einen konisch vorspringenden Abschnitt (49b) an seinem strömungsabsseitigen Ende aufweist und wobei die umgebende Hülle ein Element (42) mit einem konvergierenden Durchgang (42a) der gleichen Neigung wie der konisch vorspringende Abschnitt (49b) enthält, wobei der Abschnitt (49b) in den Durchgang (42a) hineinragt und die Stifte (P) so befestigt sind, daß sie vom genannten strömungsabsseitigen konischen Abschnitt (49b) in Achsrichtung parallel zueinander vorstehen.

#### Revendications

1. Organe (C) de filière à aiguilles multiples pour recevoir une matière extrudée issue d'un malaxeur ou autre source d'écoulement sous pression et pour décharger la matière sous une forme cylindrique, ayant plusieurs perforations s'étendant axialement, comprenant:
  - a) une coque (éléments 39, 42) ayant un canal d'entrée (36) et un canal de déchargement (42b),
  - b) et plusieurs aiguilles allongées (P) s'étendant axialement jusque dans ledit canal de déchargement (42b) pour former lesdites perforations à mesure que sort ladite matière, caractérisé en ce que
  - c) ladite coque comporte une pièce centrale axiale (39b) reliée à la coque par des ailettes (39c) à orientation radiale ayant des surfaces (45a) convergeant vers l'amont, les ailettes définissant circonférentiellement entre elles plusieurs passages (45) à extension axiale par lesquels des flux de matière s'écoulent depuis le canal d'entrée (36) jusqu'au canal de déchargement (42b); et
  - d) ladite pièce centrale (39b) comporte à son extrémité axialement amont un élément saillant (48) de forme conique qui pénètre dans le flux et répartit uniformément le flux entre lesdits passages (45).
2. Organe de filière selon la revendication 1, dans lequel les canaux d'entrée et de déchargement (36, 42b) et lesdits passages (45) à extension axiale s'étendent tous obliquement depuis l'axe, selon un angle approximativement égal ou inférieur à une quinzaine de degrés.
3. Organe de filière selon la revendication 1, dans lequel ladite pièce centrale (39b) comporte à son extrémité axialement aval une partie saillante (49b) de forme sensiblement conique, et plusieurs aiguilles allongées (P) à extension axiale s'étendent depuis ladite partie aval sen-

siblement conique (49b) jusque dans ledit canal de déchargement (42b).

4. Organe de filière selon la revendication 1, dans lequel lesdits passages (45) ont axialement une forme sensiblement en sablier.
5. Organe de filière selon la revendication 1, dans lequel lesdits passages (45) ont des surfaces périphériques intérieures et extérieures (45b) à convergence axiale qui sont réunies à des surfaces intérieures et extérieures (45a) à convergence axiale des ailettes radiales en formant des ouvertures (collets 45d) en forme de segments.
6. Système de filière (M) comprenant plusieurs organes (C) de filière selon la revendication 1 et comprenant en outre un moyen formant bloc de canaux de filière (moitiés 26 de collecteur) ayant un canal d'entrée (27) à section transversale circulaire se fondant dans un passage (28) à section en forme de chiffre huit (Fig. 13) qui diverge en ligne courbe en une paire de passages ramifiés séparés (30) à section transversale circulaire (Fig. 14) perpendiculairement à leur axe d'extension, lesdits organes (C) de filière étant disposés en aval desdits passages ramifiés (30) et communiquant avec ces derniers.
7. Système de filière selon la revendication 6, dans lequel ladite pièce centrale (39b) de chaque organe (C) de filière comporte à son extrémité axialement amont une partie saillante (48a) de forme conique pénétrant dans le flux et répartissant le flux d'une manière uniforme entre lesdits passages (45) tout en évitant la formation de "points morts" et la perte d'homogénéité, lesdits passages ramifiés (30), la partie saillante (48a) de forme conique, lesdits canaux d'entrée et de déchargement (36, 42b) et les passages (45) à extension axiale s'étendant tous obliquement depuis l'axe suivant un angle égal à environ une quinzaine de degrés ou moins.
8. Système de filière selon la revendication 6, dans lequel ledit passage (28) à section en chiffre huit est formé par des selles opposées (28c) qui se rétrécissent progressivement pour amener le passage (28) à section en huit à se fondre dans les passages ramifiés (30).
9. Système de filière selon la revendication 6, dans lequel lesdits passages ramifiés (30) s'incurvent chacun radialement en divergeant et ensuite se recourbent en sens contraire selon



un rayon ( $r$ ) non inférieur à huit fois le rayon ( $r'$ ) des passages ramifiés (30).

10. Système de filière selon la revendication 9, dans lequel lesdits passages ramifiés recourbés (30) à section transversale circulaire se fondent à nouveau dans des passages (30b) à section transversale en chiffre huit (Fig. 16) qui divergent en des passages (35) à section transversale circulaire (Fig. 18). 5 10
11. Système de filière selon la revendication 8, dans lequel le moyen formant bloc de canaux est constitué de deux moitiés (26) de collecteur ajustées l'une à l'autre, avec le canal d'entrée (27), les passages (28) et les passages ramifiés (30), une moitié dans chaque, lesdites selles (28c) se trouvant dans chacune desdites moitiés. 15 20
12. Système de filière selon la revendication 6, dans lequel ladite pièce centrale (39b) possède une partie en saillie conique (49b) à son extrémité aval, et ladite coque d'enveloppe possède un organe (42) avec un passage convergent (42a) ayant la même inclinaison que la partie en saillie conique (49b) saillant dans ledit passage (42a), lesdites pointes (P) étant montées de sorte à saillir de ladite partie conique (49b) avec parallélisme axial. 25 30

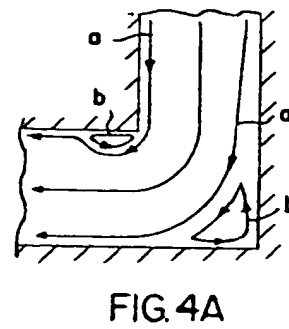
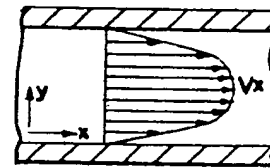
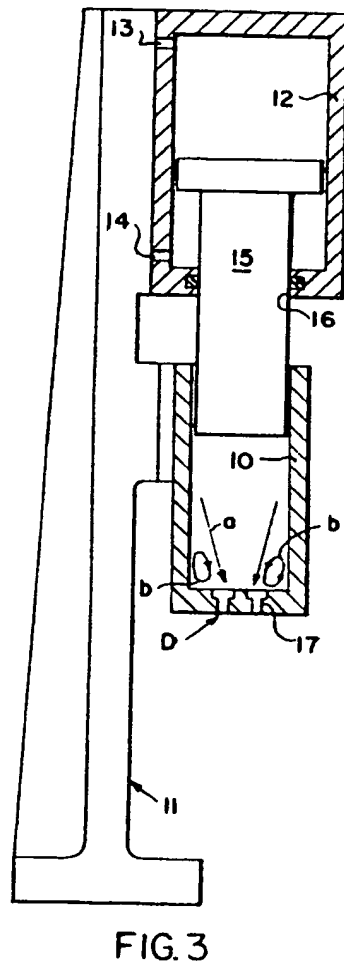
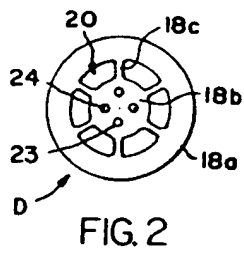
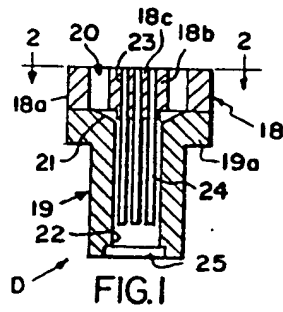
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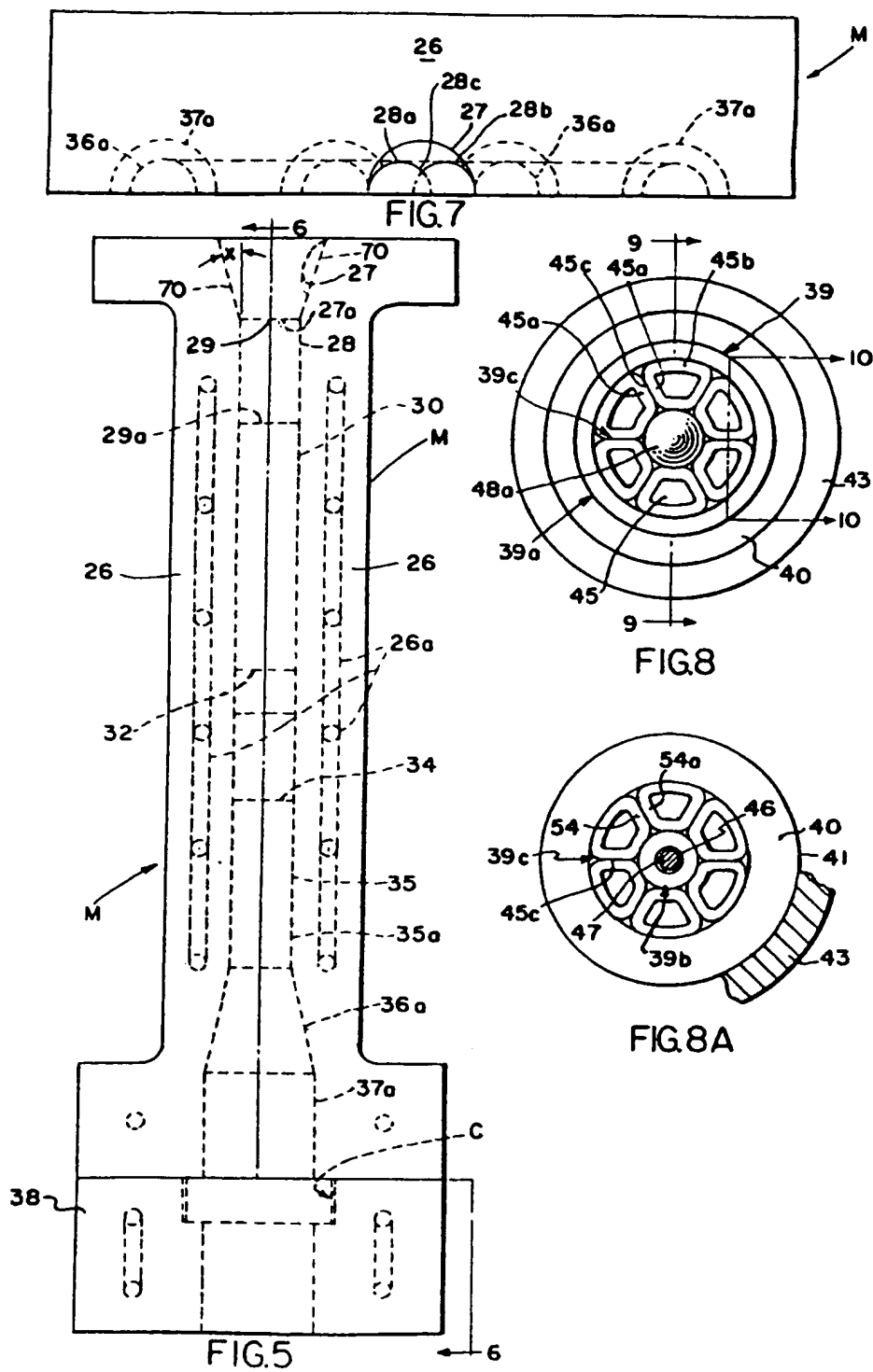
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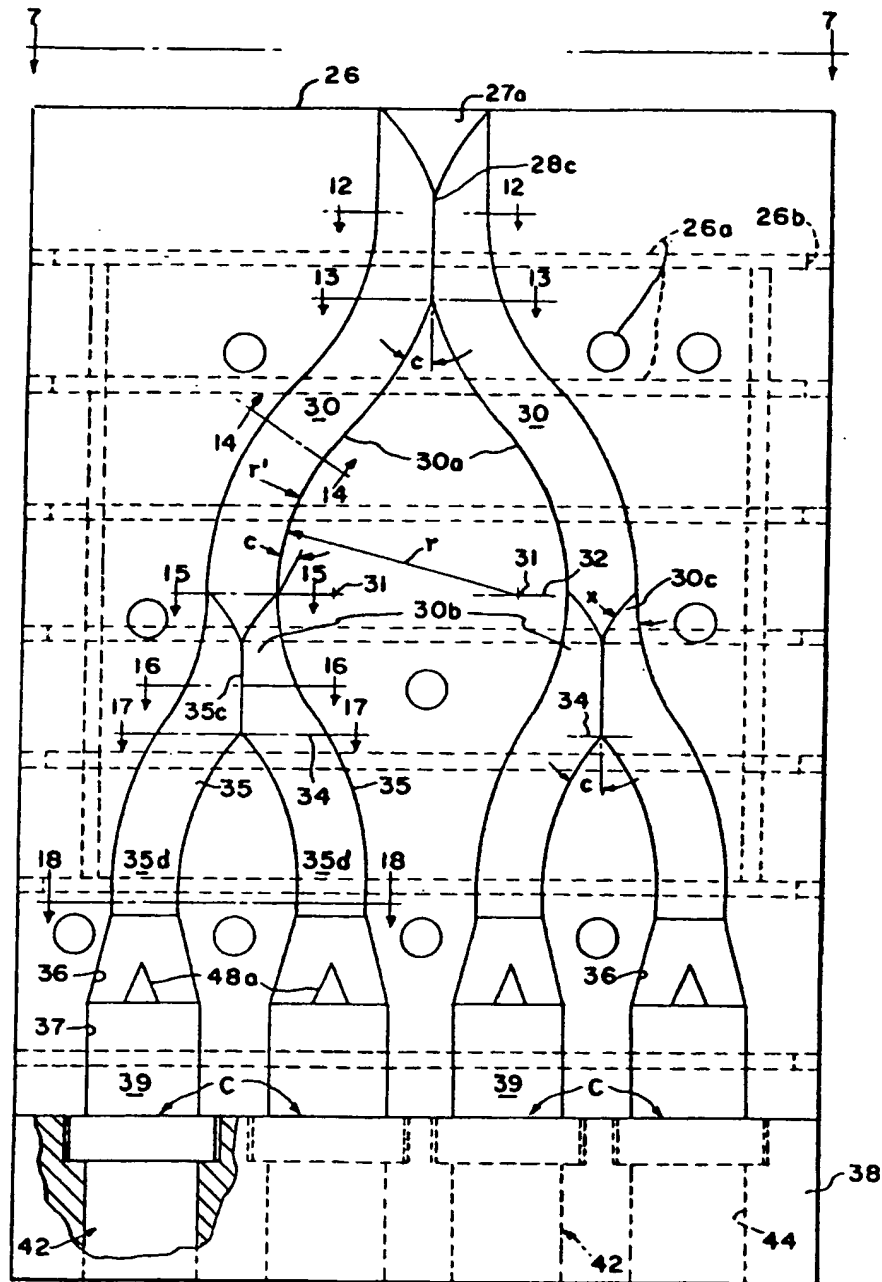


FIG.6

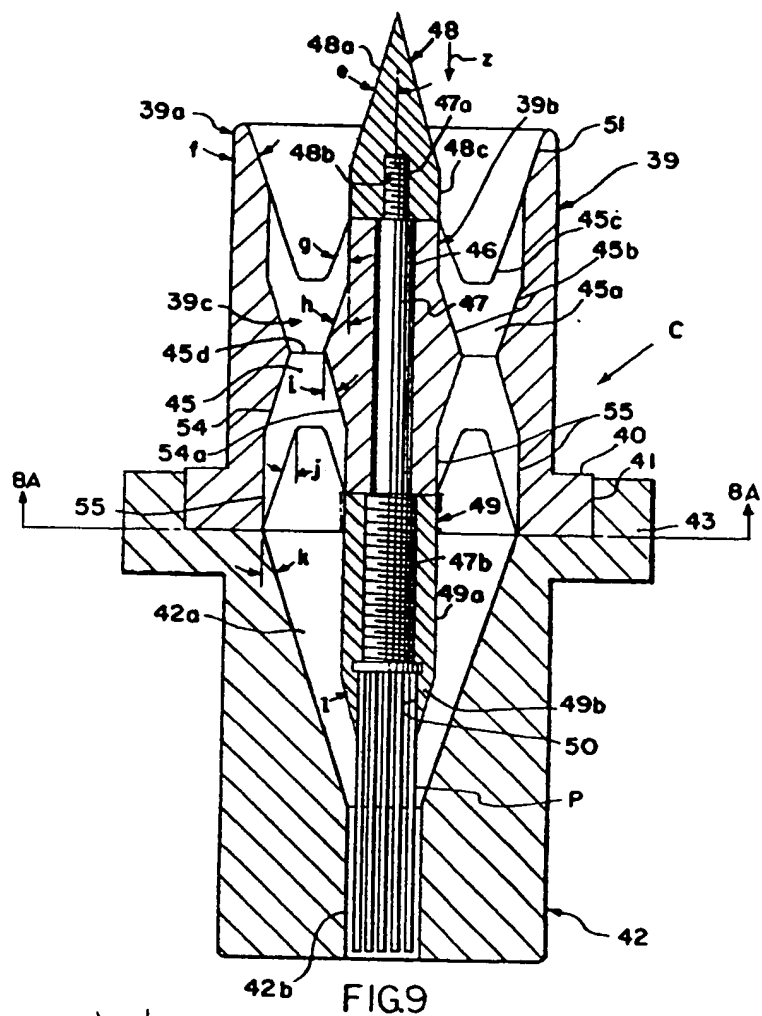


FIG.9

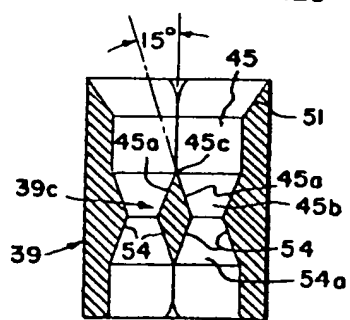


FIG. 10

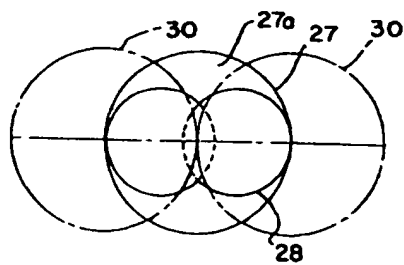


FIG. 11

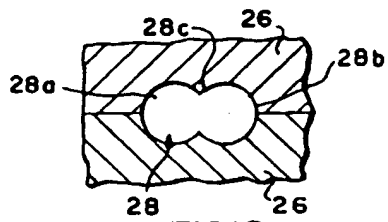


FIG. 12

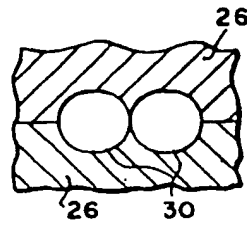


FIG. 13

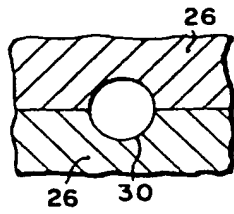


FIG. 14

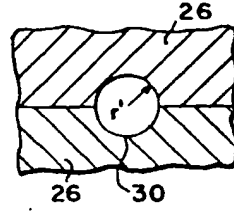


FIG. 15

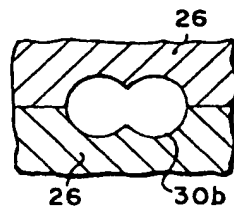


FIG. 16

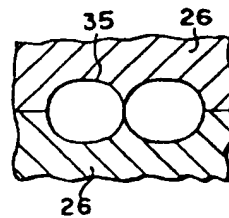


FIG. 17

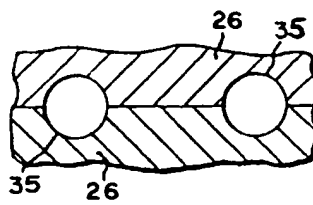


FIG. 18